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## Fuel processor will improve power generation overseas

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WRIGHT-PATTERSON AFB, Ohio — Researchers at the Air Force Research Laboratory's Materials and Manufacturing Directorate (ML) are developing a deployable Logistics Fuel Processor that will permit development of a compact, highly reliable fuel cell power system. This processor serves as an alternative to current Mobile Electric Power (MEP) systems.

The fuel cell power system will be significantly lighter and leaner than current MEP systems, allowing for easy deployment of infrastructure elements needed to sustain overseas operations.

Today's Air Force must be increasingly prepared to rapidly deploy and indefinitely sustain forces to protect vital U.S. interests. Operations abroad require mobile, air deployable infrastructure elements to stage and support land and air operations in remote locations. MEP is one of the seven essential deployment infrastructure elements.

According to Aly Shaaban, an engineer with ML's Air Expeditionary Forces Technologies Division, a Logistic Fuel Processor will extract hydrogen from logistic fuel, such as JP-8, and feed hydrogen to a fuel cell stack that generates electricity. "The compact and modular power generator we are developing, which consists of the fuel processor and fuel cell, will enable a 16 percent reduction in deployment airlift requirements, and will offer lower emissions, infrared signature and noise levels. It will also reduce power generation sustainment costs by 50 percent," Shaaban said.

Shaaban said that an effective approach to reducing the size and response time in fuel processors is to combine catalytic steam reforming with micro-channel technology in a slab configuration. Micro-channels are small passages, less than 500 microns wide. The channels improve heat transfer, and enhance catalytic residence time, and heat and mass transfer.

"Because the technology is so compact and modular in design, it will allow integration in both portable units and large electrical generators," Shaaban said. Using micro-channels, Shaaban and his peers have developed a prototype logistic fuel processor that extracts enough hydrogen to produce 3kW of electricity. This development demonstrates the potential for an eight cubic foot 800 kW logistics fuel processor. This will permit



A Mobile Electric Power-12 (MEP) generator

development of an integrated processor/fuel cell stack that would outperform conventional MEP generators at a fraction of their size.

In the past, researchers have faced challenges in developing this kind of technology because the logistics fuel's sulfur content will poison fuel cells. Coking is an additional pitfall related to reforming heavy hydrocarbon fuels such as JP-8 and diesel. However, Shaaban said that the directorate's processor is capable of removing 99.98 percent of the sulfur that exists in fuel. Using new hydrogen membrane technology and an improved reforming process, the processor removes impurities such as carbon monoxide, carbon dioxide, and hydrogen sulfide and produces ultra-clean hydrogen.

The new fuel processor also uses an efficient radiant burner, developed by engineers in the lab, and a compact micro-channel evaporator to produce the high temperature steam needed for the fuel reforming process. A compact condenser unit recovers water from 100 percent humid fuel exhaust and recycles it for future reforming.

Air Force researchers expect to have completed a 3 kW fuel cell power generator by the end of 2002 and a 10kW generator by the end of 2005. @